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TAXONOMIC STUDIES ON THE HYDRAS OF NORTH AMERICA. V[1]

DESCRIPTION OF *HYDRA CAULICULATA*, N.SP., WITH NOTES ON OTHER SPECIES, ESPECIALLY *HYDRA LITTORALIS*

BY LIBBIE H. HYMAN

DESCRIPTION OF *HYDRA CAULICULATA*, NEW SPECIES

GENERAL CHARACTERS.—This hydra greatly resembles in general appearance *Hydra carnea* L. Agassiz, 1850, previously described (Hyman, 1931*a*), and was at first thought to belong to this species or at best to constitute a variety of *carnea*. Further study, however, and the eventual finding of sexual forms have led me to consider it a separate species. *Hydra cauliculata* (Fig. 1) is of moderate size, of medium brown color, and with tentacles longer than the column, mostly 1 1/2 to 2 times the column length. Its distinctive characteristic, which differentiates it from other American species assigned to the genus *Hydra*, is the slender stalk. As pointed out in the first paper of this series (Hyman, 1929) in all hydras the column is divisible into the thicker distal stomach or body region in which food is digested, and the more slender pale proximal region, the stalk, extending from the budding zone to the pedal disk. This stalk region differs histologically from the other body regions of hydra, having very clear vacuolated entoderm cells and lacking entodermal gland cells. In some hydras, which were separated by Schulze (1917) into the genus *Pelmatohydra*, the pale slender stalk contrasts markedly with the stout dark brown stomach region. Schulze left in the genus *Hydra* (strict sense) only those species in which the distinction between stomach region and stalk is not very noticeable. The present species lies between the two extremes and should possibly be allocated to the genus *Pelmatohydra;* but its affinities in other respects with species of *Hydra* have led me to place it in that genus. In *Hydra cauliculata*, then, the stalk is noticeably more slender than the stomach region (whence the specific name, from the Greek *kaulos*, a stalk) so that well-fed specimens of this species often resemble *Pelmatohydra oligactis* (the common

[1] See bibliography at end of this article for references to Nos. I to IV, inclusive, of this series.

brown hydra) except for their smaller size and lighter coloration. The tentacles are usually six in number and take on the attitudes characteristic of long-tentacled hydras (see Hyman, 1930). They arise unevenly on buds as is usually the case in long-tentacled species but no definite order of appearance of the tentacles on buds has been noticed.

NEMATOCYSTS.—The nematocysts of this species unfortunately offer nothing distinctive and are scarcely to be distinguished from those of *Hydra carnea.* They are of a type characteristic of a number of species of hydras. In referring to nematocysts I shall hereafter adopt the terminology of Weill (1934) whose extensive studies on coelenterate nematocysts have enabled him to invent a logical system of nomenclature for these bodies. In Weill's terminology, the large barbed nematocysts of hydras, called penetrants by German writers, are renamed STENOTELES; the small rounded type which emits a coiled thread, the volvent of the Germans, is called a DESMONEME; and the intermediate sorts with a simple long tube ("thread") are termed ISORHIZAS, in place of the German name glutinants. There are two kinds of glutinants in hydras, a larger sort with a spiny tube, and a smaller sort with a smooth tube. These become holotrichous and atrichous isorhizas, respectively, in Weill's system. In *Hydra cauliculata,* the stenoteles are relatively small, ranging from 9 to 14 μ, most being about 12 μ along the longest diameter. The holotrichous isorhizas (Fig. 2, *c, d*) are of the elongated oval shape characteristic of most hydras with about three transverse or diagonal coils of the tube near the end of discharge. They are 8–10 μ in length. The small or atrichous isorhizas (Fig. 2, *b*) and the desmonemes (Fig. 2, *a*) are of about the same length, 5–6 μ. The chief difference from *H. carnea* is that in *H. cauliculata* the desmonemes are as long as or longer than the small isorhizas while in *carnea* they are smaller.

SEX ORGANS.—In order to differentiate the present species with certainty from *H. carnea,* it was highly desirable to secure sexual specimens. Repeated attempts to induce sexuality by alteration of temperature were finally successful. The species differs from *carnea* in that it is dioecious; but both testes and embryonic theca resemble those of *carnea.* The testes (Fig. 3) are larger and more plump than those of *carnea,* but are of the mammiform type common to a number of species of hydra. The embryonic theca (Fig. 4, *a, b*) is spherical and covered with flat-topped spines as in *carnea* but the spines are somewhat longer. The entire embryonic theca was found to have a diameter of 0.43 mm. and the spines were 0.045 mm. long. Unfortunately no measurements were

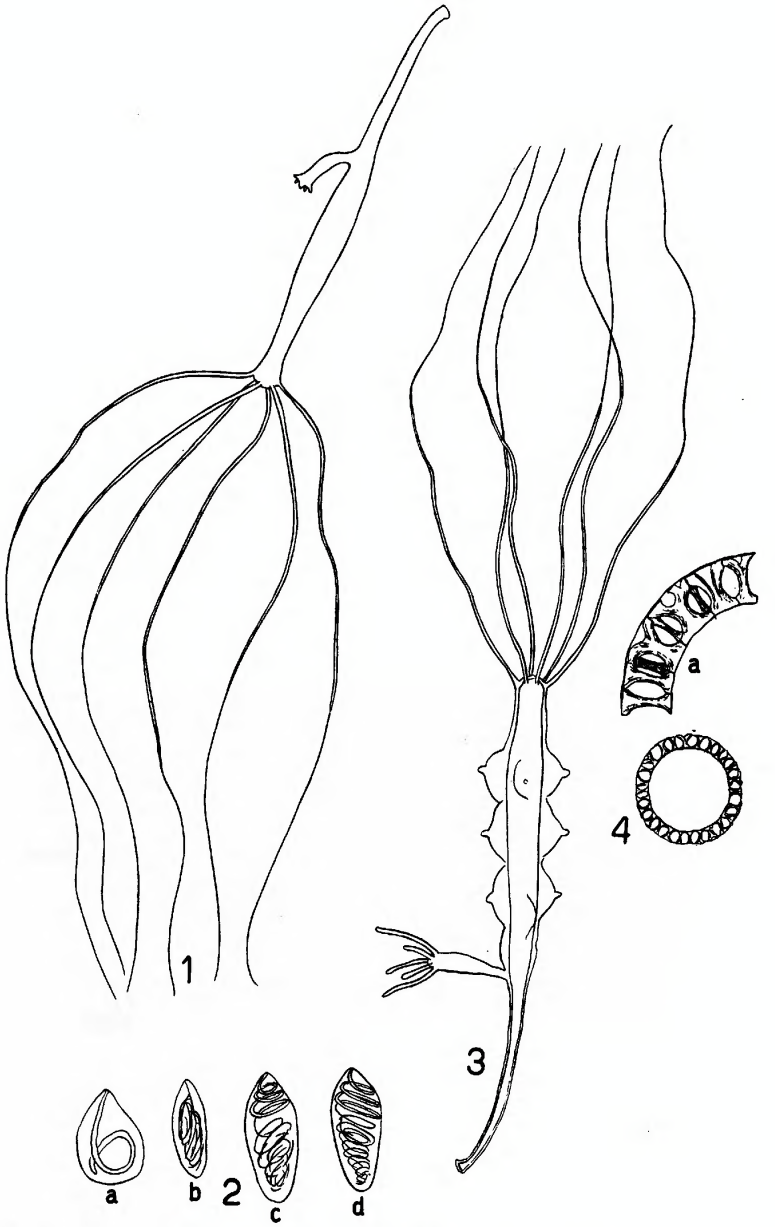

Fig. 1. *Hydra cauliculata*, n.sp., from life.

Fig. 2. Nematocysts of *Hydra cauliculata*, from life. *a*, desmoneme; *b*, atrichous isorhiza; *c*, *d*, holotrichous isorhizas.

Fig. 3. Male of *Hydra cauliculata*, from life.

Fig. 4. Developing egg of *H. cauliculata*, showing the spiny theca. *a*, a small part of the theca, enlarged.

made of the spines of the theca of *H. carnea* but the present figure 4 *a* may be compared with figure 13 in my 1931 publication. The shape of testes and the shape and length of the spines of the embryonic theca leave no doubt that *H. cauliculata* is distinct from other American species, although closely related to *H. carnea.*

DISTRIBUTION.—The material on which the description is based originated from a few specimens which were brought to me by Dr. C. E. Hadley who collected them in a stream-fed pond near Montclair, New Jersey. Successful cultures were reared from the original specimens and were kept under observation for some time. It is my opinion that hydras previously received from a lake at Gainesville, Florida, through the courtesy of Mr. R. P. Trogdon, were also of the species under consideration. These Florida specimens were also made the basis of successful cultures and were maintained for many months, but in the end I was not sure that a mixture had not occurred between the New Jersey and Florida cultures. Because of this possibility, it has seemed best to base the description on the New Jersey material and to consider Montclair, New Jersey, to be the type locality. It is probable that *Hydra cauliculata* is common in the Atlantic coast states; but it is not identical with the unnamed hydra mentioned by Papenfuss (1934) from the vicinity of Baltimore. Miss Papenfuss' species is undoubtedly, as she remarks, distinct from any of the described American species of hydra; but further data are needed before her species can be adequately defined.

Type Specimen: Cat. No. 1970, American Museum of Natural History.

SUMMARY.—*Hydra cauliculata,* à new species from Montclair, New Jersey, has the following distinguishing characteristics: moderate size, tentacles 1 1/2 to 2 times the column length; desmonemes smaller than the small isorhizas; dioecious; testes mammiform, plump; embryonic theca spherical with spines of moderate length. The last four characters differentiate *H. cauliculata* from its nearest relative, *H. carnea,* in which the desmonemes are as long as the small isorhizas and which is hermaphroditic with lower testes and shorter thecal spines.

FURTHER NOTES ON *HYDRA LITTORALIS* HYMAN, 1931

I am fortunately able to complete the description of this, the most interesting endemic American hydra, and to furnish new data on its distribution. The finding of this species in several new swift-water habitats has confirmed my surmise that this species lives only in moving

water. *Hydra littoralis* was originally found in company with a typical swift-water fauna in great abundance on the under surface of stones in the Yacht Harbor in Jackson Park, Chicago, at a place where the harbor exits into Lake Michigan and which is subject to constant wave action, often quite vigorous. The same species was later found in another part of the lagoon in the same park in a site subject to a considerable water current. From these findings, together with my failure to cultivate the form successfully in the laboratory, I concluded that the species must be confined to moving water, unlike most hydras, which are characteristic of still or relatively quiet waters.

I have now to record the taking of *Hydra littoralis* in two swift-water localities near New York City, in both cases under stones in spillways from lakes. In the spring of 1935 I was informed of the occurrence of hydras on the under side of stones in a spillway from Grassy Sprain reservoir, an artificially made lake near Yonkers, N. Y. The information came from members of the City College of New York and I was taken to the site through the courtesy of Mr. Louis Robinson, then a student at this institution. From the reservoir, formed by the damming of a stream, an artificially constructed spillway descends in steps and finally joins a spring-fed stream. Some of the stones cemented into the bottom of the artificial channel have come loose and on their under sides hydras live in fair abundance subject to a strong current when the reservoir is full. As in the Chicago habitat, the hydras here were living in company with typical swift-water animals, mostly insect larvae. The hydras were carefully examined and found to be identical with the Chicago specimens of *Hydra littoralis*. Unlike the latter, however, they were easily cultivated in the laboratory, especially if algae or other green plants were present in the culture.

Recently, in March, 1937, Mr. Robinson brought me typical specimens of *Hydra littoralis* which he had collected under stones in a spillway at Pompton Lake, New Jersey. These were also cultivated and sexual specimens very soon appeared in the cultures from which I was at last able to secure fertilized eggs, hitherto unknown.

Hydra littoralis has also been found under stones in a creek near Norman, Oklahoma, associated with a swift-stream fauna (Trowbridge, Bragg, and Self, 1936), on March 17, 1936. Young males as well as budding individuals were noted.

The finding of the species in such widely separated localities as Oklahoma, Chicago, and New York indicates that *H. littoralis* is widespread throughout the United States in a variety of swift-water habitats, such

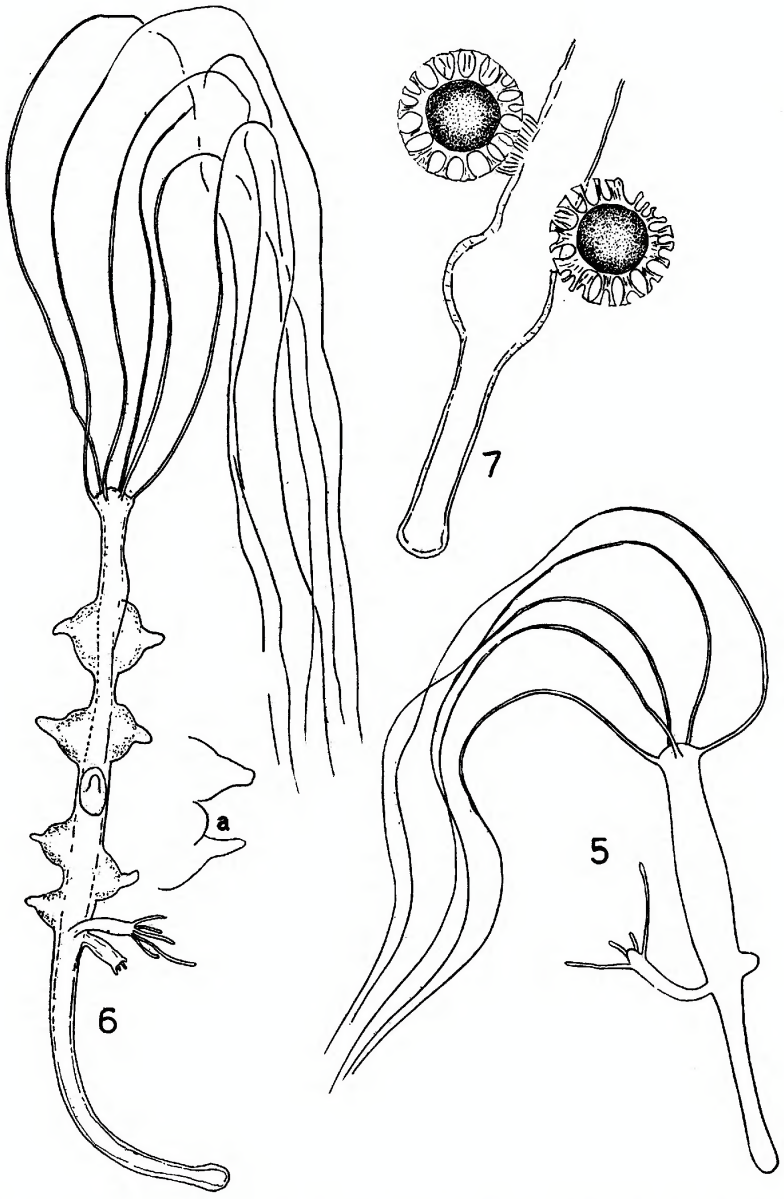

Fig. 5. *Hydra littoralis* Hyman, 1931. Laboratory culture, showing full extent of tentacles.

Fig. 6. *Hydra littoralis*, from life, old male, with maximum development of testes. *a*, some other shapes of testes.

Fig. 7. *Hydra littoralis*. Female, basal region only, showing two developing eggs each with a long-spined theca, whole mount.

as ordinary swift streams, spillways, and shores subject to wave action. It is hoped that zoölogists will be on the lookout for the species in such types of habitat in other localities.

As already mentioned I was able to cultivate New York specimens successfully and can therefore now complete the description of the species. Under cultivation the species loses the unusual green, orange, and pink tints which it displays in nature and becomes of the ordinary medium brown color common to hydras. The natural colors therefore probably result from the type of food available in the habitat. The kinds of animals suitable for food (probably insect larvae) would undoubtedly be different in the swift-water habitats where *H. littoralis* lives than in the pond habitats characteristic of most hydras.

The full spread of the tentacles was seen whenever the laboratory cultures were in good condition and is shown in figure 5, drawn from life. The tentacles attain a length of about 1 1/2 times that of the column and take on the attitudes characteristic of long-tentacled species.

In Chicago, male specimens were found in nature in the late fall, and consequently it was concluded that sexuality is induced in this species as in most other hydras by a falling temperature. Trowbridge, Bragg, and Self (1936), however, found young males in March, and the culture which I started from specimens brought to me from Pompton Lake in March soon became sexual. Later this same culture on being returned to room temperature after a short exposure to low temperature (5°C) again displayed sexual activity. It therefore appears that in *Hydra littoralis* sexuality is induced by either a falling or a rising temperature and there must be two sexual periods annually in nature.

Fully-developed males and females were seen in the Pompton Lake culture. A mature male is shown in figure 6. It is evident that the males previously depicted (Hyman, 1931*b*) were not at the maximum of testes development. The testes start out as long low ridges which eventually break up into separate testes. When fully mature these testes are high and plump with very long and stout nipples, differing from those of other hydras in their size. Figure 6 gives the typical appearance of an old male from life and figure 6 *a* shows some other variations in testis form.

Although, as is usual among hydras, the males far outnumbered the females in the culture, some females fortunately appeared, some days after testis formation was initiated, and at last I had the good luck to see the fertilized eggs of this species. Each female produced only two or three eggs, generally one at a time, occasionally two simultaneously. A

female with two embryos each inclosed in its theca is drawn in figure 7, from a mounted slide. The theca is spherical with very long spines, similar to those of *Hydra americana* (Hyman, 1929). The spines are often somewhat scanty in number. Measurements of several thecae gave the following figures: diameter of entire theca, 0.45 to 0.55 mm., majority 0.45 to 0.50 mm.; length of spines on typical thecae, 0.08 to 0.12 mm. One or two eggs were observed with short spines, 0.06 to 0.07 mm. long, but there was evidence that these eggs had been disturbed during the process of formation of the theca.

McConnell (1935) has recently maintained that the form of the embryonic theca is not a reliable taxonomic character because it is subject to alteration under altered environmental conditions. His contention does not carry conviction because the conditions of his experiments are not clearly stated. An atypical spination of the thecae was observed after transfer of hydras to foul or low oxygen water but it is not stated at what stage of egg production the transfer occurred. Any disturbance of a hydra after the ripe egg has been extruded results in malformation of the theca. Further, hydras will not live in foul or low oxygen water and hence in nature there would be no thecae formed under such conditions. I have found the shape and spination (or lack of spination) of the embryonic theca reasonably constant for each species. In the case of every species which I have described and of which I have figured the theca, at least several embryos with thecae were seen and in some species many thecae have been available for observation. In the case of the two species here under consideration, *H. cauliculata* and *littoralis*, about a dozen thecae of each have been seen.

There are now known in the United States four species of *Hydra* with spherical spiny thecae. With regard to length of the spines, these species fall into the following order, arranged from shortest to longest spines: *carnea, cauliculata, americana, littoralis. Pelmatohydra oligactis* and *pseudoligactis* and *Hydra canadensis* Rowan, 1930, have a spineless spherical theca and *H. utahensis* is characterized by the spineless helmet-shaped theca.

DISTRIBUTIONAL NOTES ON OTHER SPECIES

Hydra americana Hyman, 1929 (white hydra).—This very well-defined species has been personally identified in collections from the following localities: Princeton, New Jersey, courtesy Professor Ulric Dahlgren; Montclair, New Jersey, courtesy of Dr. C. E. Hadley; Van Cortlandt Park, New York City, courtesy of Mr. Joseph Silberstein; and

Mt. Desert Island, Maine. Bragg (1937) has recently recorded finding the species near Norman, Oklahoma. These records indicate that this species, previously officially recorded only from around Chicago, is widespread throughout the United States.

Pelmatohydra oligactis (Pallas), 1766 (brown hydra).—This species has been personally identified in collections from: Rochester, New York, courtesy Dr. Mary Rawles; Van Cortlandt Park, New York City, courtesy Mr. Joseph Silberstein; and Montclair, New Jersey, courtesy of Dr. C. E. Hadley. Miller (1936) found it common in Douglas Lake, Michigan.

Pelmatohydra pseudoligactis Hyman, 1931 (false brown hydra).—Miller (1936) records this species from Douglas Lake, Michigan. So far this hydra has been taken only in the midwestern states. As it can be distinguished from *P. oligactis* only by microscopic examination of the nematocysts (or finding of males), it has probably been frequently misidentified as *oligactis* in the past, and consequently some of the older records of *oligactis* may really have concerned *pseudoligactis*.

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